Special Roles of Registers

- BX can be used as Address register
- CX is used as default down counter register

DX is used to hold

- 16-bit I/O port address in variable port addressing
- MS 16 bits of 32 bit result after multiplication
- MS 16 bits of 32 bit numerator before division

Accumulator : 8-bit AL, 16-bit AX, 32-bit DX AX

8086 Addressing modes

8086 addressing modes for Accessing data

Immediate Addressing mode (for source operand only)

Register Addressing

Memory Addressing

I/O port addressing

Immediate Addressing Mode

		Before	After
Ex. 1: MOV DX, 1234H	DX	~~ABCDH~~	1234H

		Before	After
Ex. 2: MOV CH, 23H	CH	~~CDH~~	23H

- In Immediate Addressing mode the data follows immediately after the opcode

Register Addressing Mode

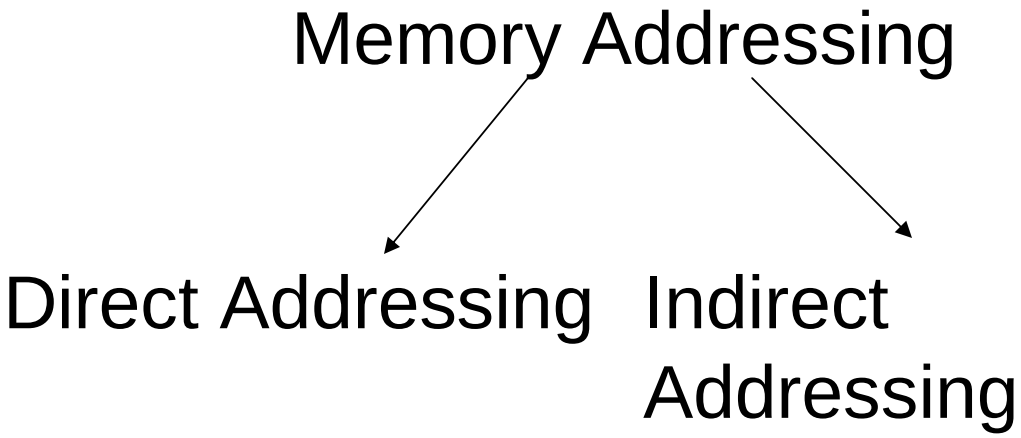
Ex.1: MOV CX, SI

	Before	After
CX	~~1234H~~	5678H
SI	5678H	5678H

Ex.2: MOV DL, AH

	Before	After
DL	~~89H~~	BCH
AH	BCH	BCH

Memory Addressing Mode



Memory Direct Addressing

Ex.1: MOV BX, DS:5634H

	Before	After	
BX	~~ABCDH~~	8645H	
DS:5634H	45H		LS byte
DS:5635H	86H		MS byte

Memory Direct Addressing contd.

Ex.2: MOV CL, DS:5634H

	Before	After
CL	F2H	45H
DS:5634H	45H	
DS:5635H	86H	

Memory Direct Addressing contd.

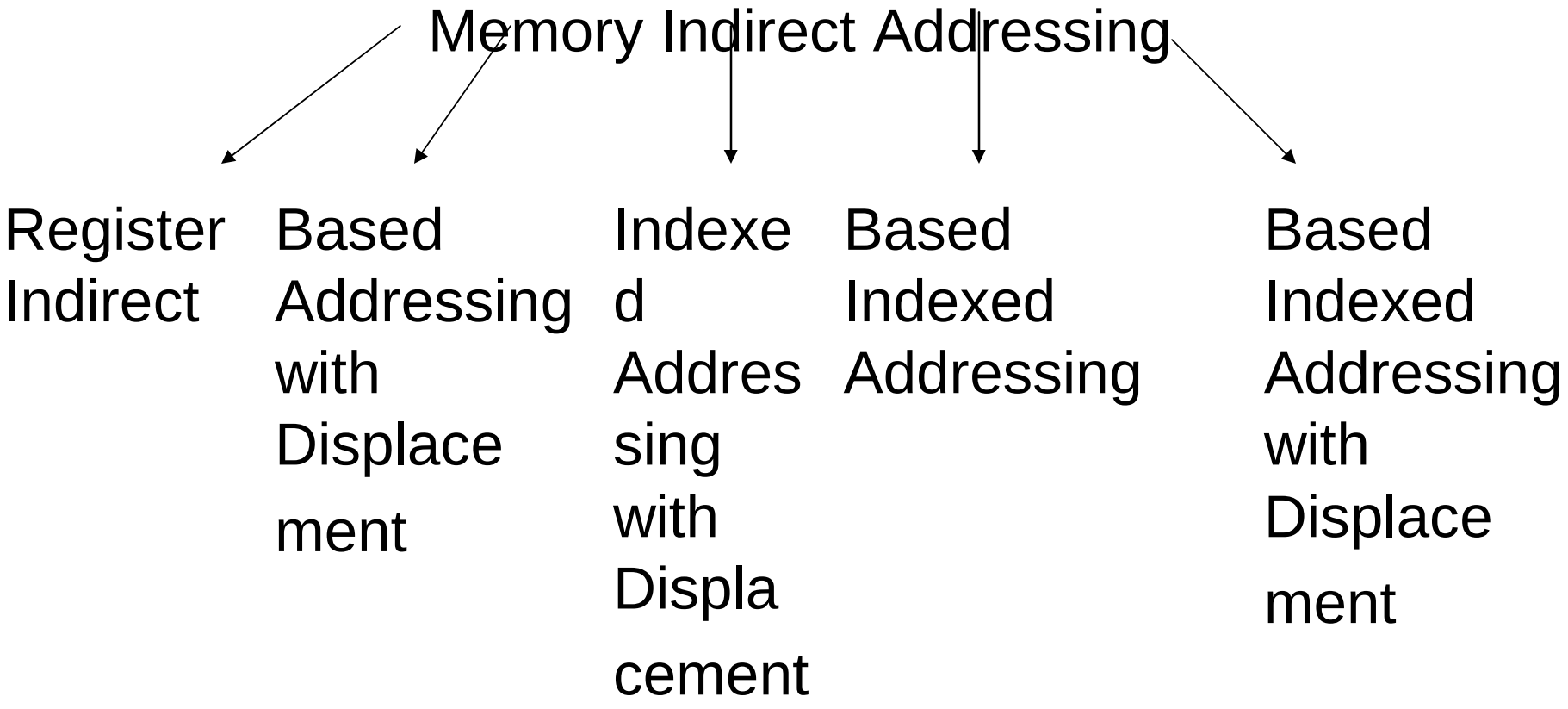
		Before	After
Ex. 3: MOV BH, LOC	BH	~~C5H~~	78H

Program

.DATA

LOC DB 78H

Memory Indirect Addressing



Register Indirect Addressing

Ex.1: MOV CL, [SI]

	Before	After
CL	~~20H~~	78H
SI	3456H	
DS:3456H	78H	

Register Indirect Addressing contd.

Ex.2: MOV DX, [BX]

	Before	After
DX	~~F232H~~	3567H
BX	A2B2H	
DS:A2B2H	67H	LS byte
DS:A2B3H	35H	MS byte

Register Indirect Addressing contd.

		Before	After
EX.3: MOV AH, [DI]	AH	30H	86H
	DI	3400H	
	DS:3400H	86H	

Only SI, DI , and BX can be used inside [] from memory addressing point of view. From user point of view [BP] is also possible. Provides 3 ways of addressing a memory operand.

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Based Addressing with displacement

		Before	After
Ex.1: MOV DH, 2345H[BX]	DH	~~45H~~	67H
2345H is 16 bit displacement	BX	4000H	
4000H+2345H = 6345H	DS:6345H	67H	

Based Addressing with displacement contd.

		Before	After
Ex.2: MOV AX, 45H[BP]	AX	~~1000H~~	CDABH
45H is 8 bit displacement	BP	3000H	
3000H + 45H = 3045H	SS:3045H	ABH	LS byte
It is SS when BP is used	SS:3046H	CDH	MS byte

Based Addressing with displacement contd.

- Base register can only be BX or BP
- Base Addressing with displacement provides 4 ways of addressing an operand in memory

Indexed addressing with displacement

		Before	After
Ex.1: MOV CL, 2345H[SI]	CL	~~60H~~	85H
2345H is 16 bit displacement	SI	6000H	
6000H+2345H = 8345H	DS:8345H	85H	

Indexed addressing with displacement contd.

Ex.2: MOV DX, 37H[DI]

37H is 8 bit displacement

5000H + 37H = 5037H

	Before	After
DX	~~7000H~~	B2A2H
DI	5000H	
DS:5037H	A2H	LS byte
DS:5038H	B2H	MS byte

Indexed Addressing with displacement Contd.

- Index register can only be SI or DI
- Indexed Addressing with displacement provides 4 ways of addressing an operand in memory

Based Indexed Addressing

Ex1:MOV CL,[SI][BX]

2000H+0300H=2300H

		Before	After
CL	~~40H~~	67H
SI	2000H	
BX	0300H	
DS:2300H	67H	

Based Indexed Addressing contd.

Ex2:MOV CX,[BP][DI]

		Before	After	
CX		~~6000H~~	6385H	
BP		3000H		
DI		0020H		
2000H+0300H=2300H	SS:3020H	85H		LS byte
It is SS when BP is used	SS:3021H	63H		MS byte

Based Indexed Addressing contd.

- Based Index Addressing Provides 4 ways of addressing an operand in memory
- One Register must be a Base register and the other must be an Index register
- For ex. MOV CX, [BX][BP] is an invalid instruction

Based Indexed Addressing with Displacement

Ex1: MOV DL, 37H[BX+DI]

37H is 8-bit Displacement

2000H+0050H+37H=2087H

	Before	After
DL	~~40H~~	12H
BX	2000H	
DI	0050H	
DS:2087H	12H	

Based Indexed Addressing with Displacement contd.

Ex2: MOV BX,1234H[SI+BP]

1234 is 16bit Displacement

4000+0020+1234=5254H

It is SS when BP is used

		Before	After
BX		~~3000H~~	3665H
SI		4000H	
BP		0020H	
SS:5254H		65H	LS byte
SS:5255H		36H	MS byte

Based Indexed Addressing with Displacement contd.

- Provides 8 ways of addressing an operand in memory

Memory modes as derivatives of Base Index addressing with disp.

Instruction	Base Reg.	Index Reg.	Disp	Addressing Mode
MOV BX, DS:5634H	No	No	Yes	Direct Addressing
MOV CL,[SI]	No	Yes	No	Register Indirect
MOV DX,[BX]	Yes	No	No	
MOV DH, 2345H[BX]	Yes	No	Yes	Base addr. with Disp.
MOV DX, 35H[DI]	No	Yes	Yes	Index addr. with Disp.
MOV CL, [SI+BX]	Yes	Yes	No	Based Index Addr.
MOV DL, 37H[BX+DI]	Yes	Yes	Yes	Base Index Addr with disp

Input/Output port Addressing

I/O port Addressing

Fixed port addressing or Direct Port addressing

Variable port addressing or Indirect Port addressing

Fixed port Addressing

Ex.1: IN AL, 83H

	Before	After
AL	~~34H~~	78H
Input port no. 83H	78H	

Fixed port Addressing contd.

Ex.2: IN AX, 83H

	Before	After
AX	~~5634H~~	F278H

Input port no. 83H	78H
Input port no. 84H	F2H

Fixed port Addressing contd.

		Before	After
Ex.3: OUT 83H, AL	AL	50H	
	Output port no. 83H	~~65H~~	50H

Fixed port Addressing contd.

Ex.4: OUT 83H, AX

	Before	After
AX	6050H	
Output port no. 83H	~~65H~~	50H
Output port no. 84H	~~40H~~	60H

Fixed port Addressing contd.

- IN and OUT instructions are allowed to use only AL or AX registers
- Port address in the range 00 to FFH is provided in the instruction directly

Variable port Addressing

- I/O port address provided in DX register only
- Port addresses range from 0000H to FFFFH
- Data transfer with AL or AX only

Variable port Addressing contd.

Ex. 1: IN AL, DX

	Before	After
AL	~~30H~~	60H
DX	1234H	
Input port no. 1234H	60H	

Variable port Addressing contd.

Ex. 2: IN AX, DX

	Before	After
AX	~~3040H~~	7060H
DX	4000H	
Input port no. 4000H	60H	
Input port no. 4001H	70H	

Variable port Addressing contd.

Ex. 3: OUT DX, AL

	Before	After
AL	65H	
DX	5000H	
Output port no. 5000H	~~80H~~	65H

Variable port Addressing contd.

Ex. 4: OUT DX, AX

	Before	After
AX	4567H	
DX	5000H	
Output port no. 5000H	~~25H~~	67H
Output port no. 5001H	~~36H~~	45H